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14.4 ppm/degree. C. Again, the back of the chip is very smooth resulting in a weak mechanical bond and any delamination or cracking of the epoxy between the chip and heat spreader causes a critical reduction in heat transfer from the chip which greatly increases the chip temperature. When this structure is subjected to storage at 130.degree. C. for 1000 hours then thermal cycling of 0 to 100.degree. C. for 1,500 cycles, then -25 to 125.degree. C. for 400 cycles, then -40 to 140.degree. C. for 300 cycles required to prove the reliability of joints between these materials, common epoxies quickly fail (delaminate). The applicants have discovered that with proper treatment a joint between silicon and nickel plated copper of either silicone adhesives (e.g. TC3280G) or flexible-epoxy adhesives (e.g. ABLEBOND 8971 and EG 7655) reliably meet the thermal cycling requirements of this test.

(23) FIG. 6 shows a direct chip attach module DCAM 300. Flip-chip 302 is attached to a multi-layer fiberglass epoxy substrate 304. Eutectic solder 306 is deposited (by hot air soldering and leveling (HASL), solder-on-chip, solder inject, by transfer from a stainless steel decal) to connect between high temperature solder bumps 308 (e.g. 95/5% Pb/Sn alloy) on the bottom of the chip and copper pads 310 on the top surface of the substrate.

(24) Copper pads 312 on the carrier substrate are positioned to connect to copper pads on an interconnect structure (organic circuit board as in FIGS. 2 and 5). Solder 314 may be provided on pads 312 for reflow soldered attachment. Alternatively, solder may be provided on the pads of the circuit board. Heat spreader 320 is attached to the back side of chip 302 using an adhesive 322 of flexible-epoxy or more preferably silicon. Improved mechanical strength can be obtained for heat spreaders which extend significantly past the limits of the chip by encapsulating between the heat spreader at 324 and substrate 304 using epoxy adhesives, silicone adhesives, or more preferably flexible-epoxy.

(25) FIG. 7 shows a computer network embodiment of the information handling system 250 of the invention. Computer

United States Patent

Bernier et al.

(1) Patent Number: 6,069,023

(4) Date of Patent: May 30, 2000

[54] ATTACHING HEAT SPREADS DIRECTLY TO FLIP CHIPS AND CERAMIC CHIP CARRIERS

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[75] Inventor: William Emmett Bernier; Michael Anthony Gaynor; Irving Mandel, both of Vestal, Minn.; Shaukatullah, Endwell, all of N.Y.

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[73] Assignee: International Business Machines Corporation, Armonk, N.Y.

[21] Appl. No.: 09/094,461

[22] Filed: Jun. 10, 1998

Related U.S. Application Data

[62] Division of application No. 08/972,673, Jun. 25, 1996, Pat. No. 5,647,928

[51] Int. Cl. 7 H01L 21/44

[52] U.S. Cl. 438/107; 438/118; 438/119; 436/222

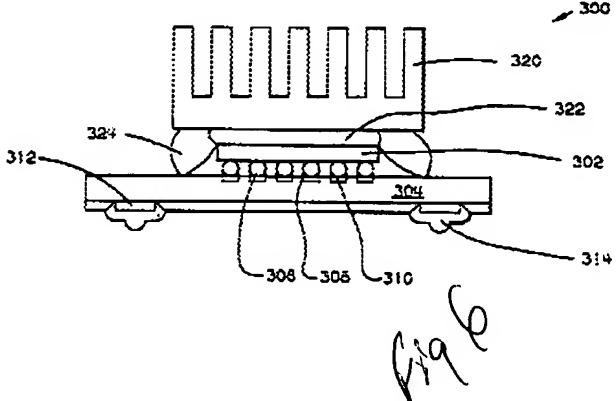
[55] Field of Search 438/107, 108, 436/115, 116, 122; 361/710, 719

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46 Claims, 13 Drawing Sheets



alumina ceramic;

Claims Text - CLTX (17):

the method further comprises filling the silicone adhesive with particles of aluminum metal;

Claims Text - CLTX (18):

the method further comprises selecting a one part silicone adhesive;

Claims Text - CLTX (32):

the depositing of silicone adhesive includes filling the space around the semiconductor chips between the heat sinks and the wiring surfaces with the silicone adhesive;

Claims Text - CLTX (50):

wherein depositing the silicone adhesive comprises depositing the adhesive between the heat sink and multiple semiconductor chips.

Claims Text - CLTX (56):

13. The method according to claim 1, wherein depositing the silicone adhesive comprises depositing the silicone adhesive around the semiconductor chips between the heat sinks and the conformal coating.

Claims Text - CLTX (58):

filling the silicone adhesive with particles of alumina ceramic.

Claims Text - CLTX (60):

filling the silicone adhesive with particles of aluminum metal.

Claims Text - CLTX (62):

selecting a one part silicone adhesive.

Claims Text - CLTX (82):

30. The method according to claim 1, wherein depositing the silicone adhesive includes filling the space around the semiconductor chip between the heat sink and the wiring surface with the silicone adhesive.

Claims Text - CLTX (106):

depositing silicone adhesive which is not fully cured between back surfaces of semiconductor chips and the heat sinks at respective windows;

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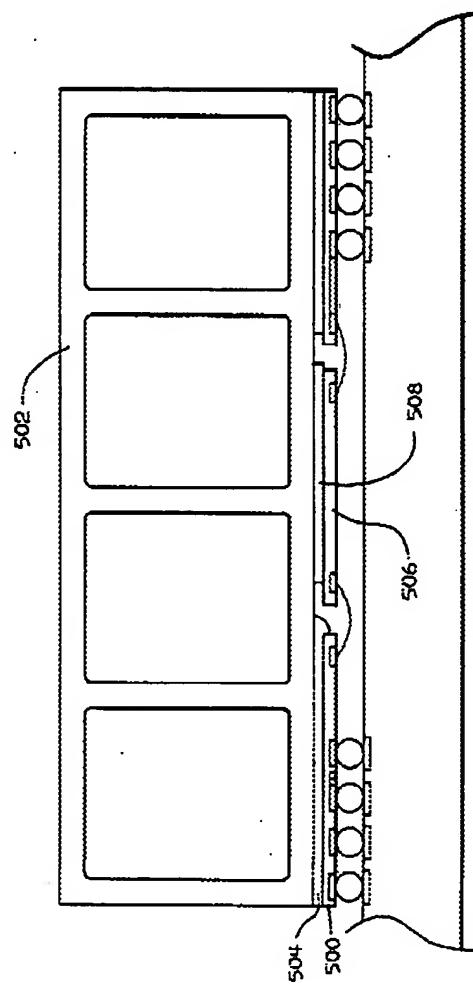


FIG. 12

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<input type="radio"/> Sub/Ent	<input type="radio"/> Down	<input type="radio"/> Part	<input type="radio"/> Right	<input type="radio"/> Occurrences	

(7) The lid 20 is shown in the form of a cap 50 having a recess 52 adapted to receive the base 14. The recess 52 is defined by four side walls 54 and a base wall 56. The base wall 56 has a central opening 57 that is adapted to receive the second layer of elastomer gel 22. The side walls 54 define a close tolerance fit with the side walls 36 of the base 14 and include a continuous rib 58 that snap fits into a continuous groove 60 formed in the side walls 36. It should be understood that the snap fit rib and groove 58, 60 are shown simply to illustrate a releasable connection, and that any suitable form of releasable connection between the lid 20 and the base 14 may be utilized. Further, while it is preferred that the lid 20 be releasably connected to the base 14, it may be acceptable in some applications to form a permanent connection between the lid 20 and the base 14, using any known form of permanent connection that is appropriate for the application. While the lid 20 may be of a multi-piece construction and formed from any suitable materials, it is preferred that the lid 20 be a unitary construction molded from a suitable polymer having low dielectric properties, such as PEI or PEEK.

(8) It is preferred that the second layer of elastomer gel 22 be formed from a film, sheet, or pad of silicon elastomer gel or fluoro silicone elastomer gel having enhanced thermal conductivity, while also having sufficient structural stability to prevent undesirable flow of the gel over an anticipated temperature range for the particular application. Experience has shown that the thermal conductivity of such elastomer gels is comparatively insensitive to compression force, thereby providing acceptable thermal conductivity at their interfaces with other surfaces without requiring large compression forces. This is due, in part, to the inherent surface wetting capabilities of such elastomer gels. It is highly preferred that the thermal conductivity of the second layer of elastomer gel 22 be enhanced by using alumina, boron nitride, or aluminum nitride additives. It is also highly preferred that these additives be 60% to 80% by volume of the elastomer gel to optimize the thermal conductivity of the second layer of elastomer gel.

(9) The electrical contacts 22 are shown in the form of small pillars

United States Patent [S]

MacDonald, Jr. et al.

[1] Patent Number: 5,905,638

[4] Date of Patent: May 18, 1999

[54] METHOD AND APPARATUS FOR PACKAGING A MICROELECTRONIC DEVICE WITH AN ELASTOMERIC GEL

[75] Inventor: James D. MacDonald, Jr., Walter M. Kirschke, both of Apex, North Carolina, City, NC

[75] Assignee: Ericsson Inc., Research Triangle Park, NC

[21] Appl. No. 08/934,818

[22] Filed: Dec. 18, 1997

[51] Int. Cl. 4 H05K 7/10, H05K 7/12

[51] U.S. Cl. 361/176, 361/177, 361/178, 361/179, 361/180, 361/181, 361/182, 437/66

[58] Field of Search: 374/217 A, 253, 174/262, 261, 324, 203/206, 724, 716, 722, 734, 736, 253/378, 658, 706, 723, 724, 727, 734, 738, 743, 745, 354/354, 356, 725, 154/1, 261/760, 787, 788-771, 774, 775, 779, 831, 837, 603, 826, 438, 117-119, 482/330, 331, 334, 66, 68, 70, 71, 72, 74, 81, 78, 94, 95, 91, 175, 179, 392, 399

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13,189,21 4,651,734 4,246,553 6,159,5 2,617,785 13,189,22 4,651,735 4,246,554 6,159,5 2,617,786 13,189,23 4,651,736 4,246,555 6,159,5 2,617,787 13,189,24 4,651,737 4,246,556 6,159,5 2,617,788 13,189,25 4,651,738 4,246,557 6,159,5 2,617,789 13,189,26 4,651,739 4,246,558 6,159,5 2,617,790 13,189,27 4,651,740 4,246,559 6,159,5 2,617,791 13,189,28 4,651,741 4,246,560 6,159,5 2,617,792 13,189,29 4,651,742 4,246,561 6,159,5 2,617,793 13,189,30 4,651,743 4,246,562 6,159,5 2,617,794 13,189,31 4,651,744 4,246,563 6,159,5 2,617,795 13,189,32 4,651,745 4,246,564 6,159,5 2,617,796 13,189,33 4,651,746 4,246,565 6,159,5 2,617,797 13,189,34 4,651,747 4,246,566 6,159,5 2,617,798 13,189,35 4,651,748 4,246,567 6,159,5 2,617,799 13,189,36 4,651,749 4,246,568 6,159,5 2,617,800 13,189,37 4,651,750 4,246,569 6,159,5 2,617,801 13,189,38 4,651,751 4,246,570 6,159,5 2,617,802 13,189,39 4,651,752 4,246,571 6,159,5 2,617,803 13,189,40 4,651,753 4,246,572 6,159,5 2,617,804 13,189,41 4,651,754 4,246,573 6,159,5 2,617,805 13,189,42 4,651,755 4,246,574 6,159,5 2,617,806 13,189,43 4,651,756 4,246,575 6,159,5 2,617,807 13,189,44 4,651,757 4,246,576 6,159,5 2,617,808 13,189,45 4,651,758 4,246,577 6,159,5 2,617,809 13,189,46 4,651,759 4,246,578 6,159,5 2,617,810 13,189,47 4,651,760 4,246,579 6,159,5 2,617,811 13,189,48 4,651,761 4,246,580 6,159,5 2,617,812 13,189,49 4,651,762 4,246,581 6,159,5 2,617,813 13,189,50 4,651,763 4,246,582 6,159,5 2,617,814 13,189,51 4,651,764 4,246,583 6,159,5 2,617,815 13,189,52 4,651,765 4,246,584 6,159,5 2,617,816 13,189,53 4,651,766 4,246,585 6,159,5 2,617,817 13,189,54 4,651,767 4,246,586 6,159,5 2,617,818 13,189,55 4,651,768 4,246,587 6,159,5 2,617,819 13,189,56 4,651,769 4,246,588 6,159,5 2,617,820 13,189,57 4,651,770 4,246,589 6,159,5 2,617,821 13,189,58 4,651,771 4,246,590 6,159,5 2,617,822 13,189,59 4,651,772 4,246,591 6,159,5 2,617,823 13,189,60 4,651,773 4,246,592 6,159,5 2,617,824 13,189,61 4,651,774 4,246,593 6,159,5 2,617,825 13,189,62 4,651,775 4,246,594 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2,617,908 13,189,145 4,651,858 4,246,677 6,159,5 2,617,909 13,189,146 4,651,859 4,246,678 6,159,5 2,617,910 13,189,147 4,651,860 4,246,679 6,159,5 2,617,911 13,189,148 4,651,861 4,246,680 6,159,5 2,617,912 13,189,149 4,651,862 4,246,681 6,159,5 2,617,913 13,189,150 4,651,863 4,246,682 6,159,5 2,617,914 13,189,151 4,651,864 4,246,683 6,159,5 2,617,915 13,189,152 4,651,865 4,246,684 6,159,5 2,617,916 13,189,153 4,651,866 4,246,685 6,159,5 2,617,917 13,189,154 4,651,867 4,246,686 6,159,5 2,617,918 13,189,155 4,651,868 4,246,687 6,159,5 2,617,919 13,189,156 4,651,869 4,246,688 6,159,5 2,617,920 13,189,157 4,651,870 4,246,689 6,159,5 2,617,921 13,189,158 4,651,871 4,246,690 6,159,5 2,617,922 13,189,159 4,651,872 4,246,691 6,159,5 2,617,923 13,189,160 4,651,873 4,246,692 6,159,5 2,617,924 13,189,161 4,651,874 4,246,693 6,159,5 2,617,925 13,189,162 4,651,875 4,246,694 6,159,5 2,617,926 13,189,163 4,651,876 4,246,695 6,159,5 2,617,927 13,189,164 4,651,877 4,246,696 6,159,5 2,617,928 13,189,165 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6,159,5 2,617,949 13,189,186 4,651,899 4,246,718 6,159,5 2,617,950 13,189,187 4,651,900 4,246,719 6,159,5 2,617,951 13,189,188 4,651,901 4,246,720 6,159,5 2,617,952 13,189,189 4,651,902 4,246,721 6,159,5 2,617,953 13,189,190 4,651,903 4,246,722 6,159,5 2,617,954 13,189,191 4,651,904 4,246,723 6,159,5 2,617,955 13,189,192 4,651,905 4,246,724 6,159,5 2,617,956 13,189,193 4,651,906 4,246,725 6,159,5 2,617,957 13,189,194 4,651,907 4,246,726 6,159,5 2,617,958 13,189,195